Process Institutionalization

Made Easy

NASA PM Challenge 2009

Stewart Bush

Brief History

BPM	Business Process Management
BPSCM	Bioastronautics Planning System Configuration Management
CCB	Configuration Control Board
JSC, KSC	Johnson Space Center, Kennedy Space Center
NIH	Not Invented Here
PI	Process Institutionalization
SLSD	Space and Life Sciences Directorate

*BPSCM is a custom built software system first deployed in December, 2005 to support some of the Directorate level control boards at SLSD. BPSCM utilizes a new **process-centric technology** called **BPM** which automates and runs the CCB process guiding all participants compliantly through procedures.*

BPM is a new technology and management paradigm which *innately* supports process based organizations and their work

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Presentation Premise

- **BPSCM initial 10 Board Deployment**
- **Rapid Growth in Use**
  - Now 45 Boards at SLSD – **Institutionalized Process**
  - KSC (UB) Directorate – deployed for use on a few boards
  - JSC (KA) Directorate – selected for use
  - Over 1000 users
- **BPSCM achieved PI much faster & easier than the norm**
- **This presentation will explore the BPSCM (PI) phenomenon**
  - Key ingredients catalyzing the PI state
  - Will this work on larger, more complex Engineering processes?
    - 7123.1, 7150.2, Safety Critical, Mission Critical, …

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Background

Tietronix

- **Established 1999 - SDB and 8(a) certified**
- **HQ - Houston, 80% business with NASA**
  - 65 employees with 75% software developers and engineers
  - PMPs in project and program management
- **Core Competencies**
  - Custom Software Development
  - **Engineering Process Automation**
  - Training, Education & Outreach
  - Graphics, Animation, Virtual Reality
  - Optical device for anti-glaring & anti-blooming
- **NASA Projects/Relationships**
  - Mission Operations
  - Space & Life Sciences
  - JSC Engineering
  - Simulation/Training

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- **Tietronix – Director of Process Technology**
- **29 years – Software Industry – many roles**

Software Developer

Lincoln Labs Hanscom AFB, Harris Corp, E-Systems

Software Manager

Texas Instruments Govt. Systems/Raytheon

Software Process Specialist

Atherton Technology

Executive & Business Management

Talarian/Tibco - Middleware

ObjectSpace – Software Infrastructure

Segue Software/Borland – Software Testing

The Mind Electric/Software AG – web services

- **Strong Process Orientation**

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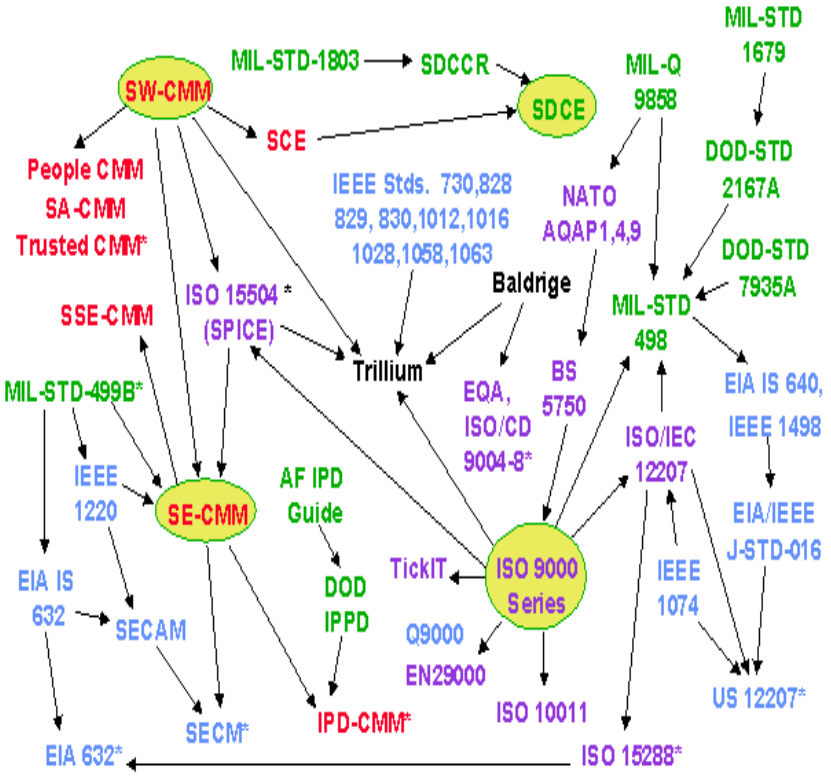
Presentation Overview

• **Best Practices, Improved Process**	We are Committed
• **Process Institutionalization**	What is it? What is it good for?
• **How do you get it …**	Overtly & intentionally
• **Short**Software**Story**	CCB Management process
• **Analysis**	Rapid Institutionalization – How?
• **Extrapolation**	Repeatable Results on larger Scale?
• **Do it Yourself**	Get/Use process-centric Technology
• **Final Thoughts**	Process Wall finally Falls?
• **Q & A**	

Process Evolution

Chief Engineer *increase awareness and consistency across the Agency and advance the practice of engineering …The engineering of NASA systems requires a systematic and disciplined set of processes … for the design development, operation, maintenance, and closeout of systems throughout the lifecycle of the programs and projects.*



Software Productivity Consortium "The Quagmire" 2000
www.software.org

ISO 9001
CMMI
ITIL
IEEE 12207
Six Sigma ...

You are here

Best Practices
Process Improvement
Institutionalization

COMPLIANCE IS MANDATORY

Resistance is Futile

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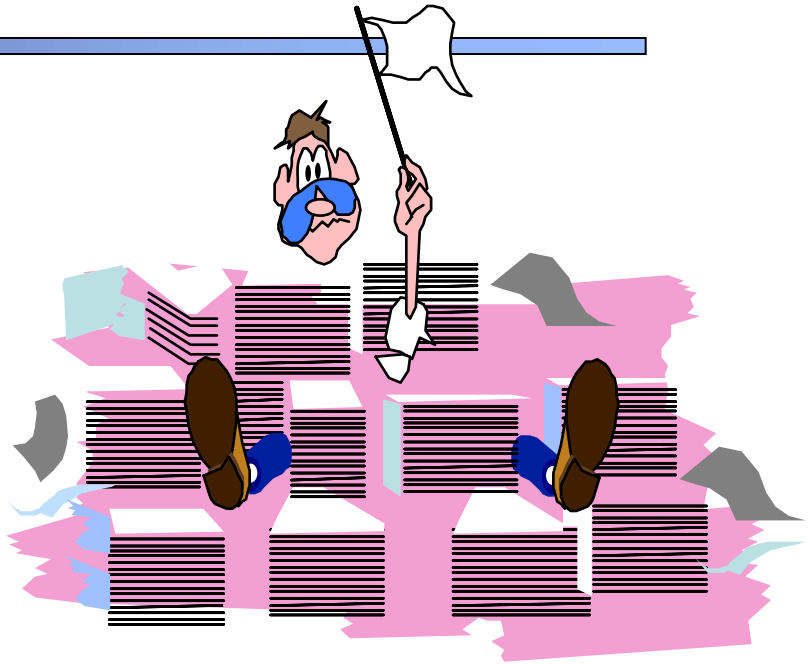
Historical, Stubborn Process Problems



- **Many still don't believe**
- **Tedious, cumbersome, manual**
- **Steep Learning Curve**
- **Complex, Confusing, Inconsistent & Distributed Doc**
- **Process Improvement hampered:**
  - Most don't understand the process
  - Those that do understand it differently
  - Centers, Directorates, Divisions, Managers – unique processes
  - Project stress can = Process abandonment
  - Variable Management Enforcement
  - Metrics & Lessons Learned – sparse & don't translate well between Other processes, projects, organizations, …
- **Dearth of useful tools to manage the Process**

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Process – Still a pretty good idea

Jan. 14: New research shows that doctors who stick with a simple pre-op checklist see a 36 percent reduction in post-operative deaths and complications.

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NASA & Process

Increased Process Focus

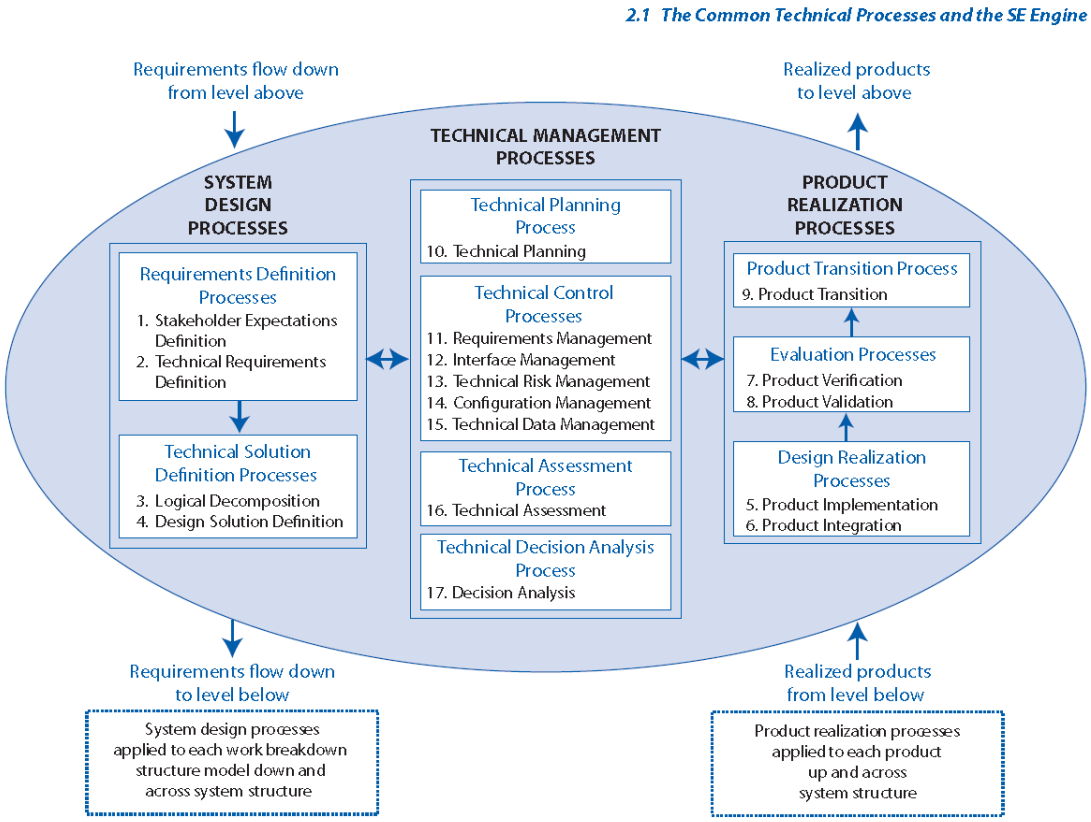
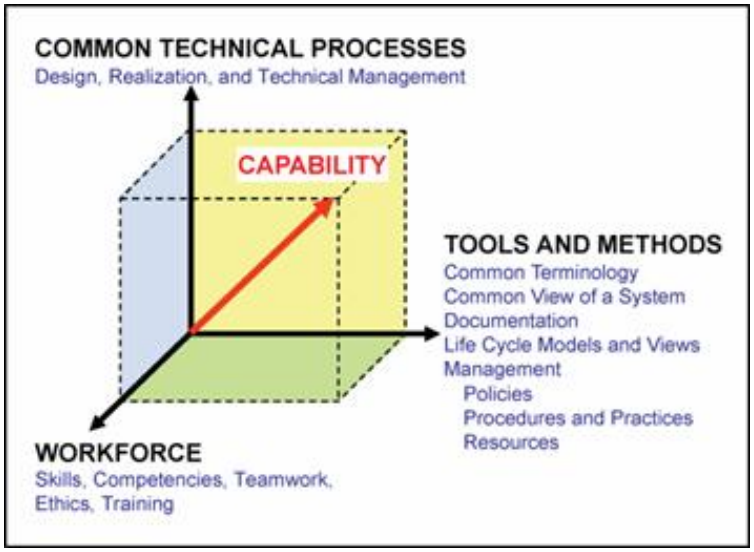


Figure 2.1-1 The systems engineering engine



Strong Call for Process Institutionalization

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Process Institutionalization

Common Sense

- **Everyone Uses & Knows the Process(es)**
  - Process is applied Consistently across Projects, Organizations, Managers, Time
  - Good and up to date training and documentation exists & is used
- **Organizational Belief in the Process**
  - Even when the project is late, re-organizing, dealing with surprises
  - Even if **COMPLIANCE WASN'T MANDATORY**
- **Obvious Benefits**
  - Eliminate ***very expensive*** 'wheel reinvention' NIH syndrome - where each group creates & manages their unique processes
  - People can easily xfer to other projects & groups with minimal learning curve
  - No process resistance tax, more capable & proficient staff, faster project execution
  - **Metrics more meaningful**, Process Improvement is actually possible
  - Lower risk, Higher Quality, Better Control & Visibility
  - Predictable, Reliable, Faster & More Frequent (Mission) Success
- **PI – should be quite Valuable**
  - In achieving **Mission Success** reliably & repeatably

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Process Institutionalization

From SEI - CMMI

Generic Goals	Generic Practices
GG1: Achieve Specific Goals	GP 1.1: Perform Base Practices
GG2: Institutionalize a Managed Process	GP 2.1: Establish an Organizational Policy GP 2.2: Plan the Process GP 2.3: Provide Resources GP 2.4: Assign Responsibility GP 2.5: Train People GP 2.6: Manage Configurations GP 2.7: Identify and Involve Relevant Stakeholders GP 2.8: Monitor and Control the Process GP 2.9: Objectively Evaluate Adherence GP 2.10: Review Status with Higher Level Management
GG3: Institutionalize a Defined Process	GP 3.1: Establish a Defined Process GP 3.2: Collect Improvement Information
GG4: Institutionalize a Quantitatively Managed Process	GP 4.1: Establish Quantitative Objectives for the Process GP 4.2: Stabilize Subprocess Performance
GG5: Institutionalize an Optimizing Process	GP 5.1: Ensure Continuous Process Improvement GP 5.2: Correct Root Causes of Problems

Institutionalization implies that the process is ingrained in the way the work is performed and there is commitment and consistency to performing the process. An institutionalized process is more likely to be retained during times of stress

Institutionalization a cornerstone of CMMI

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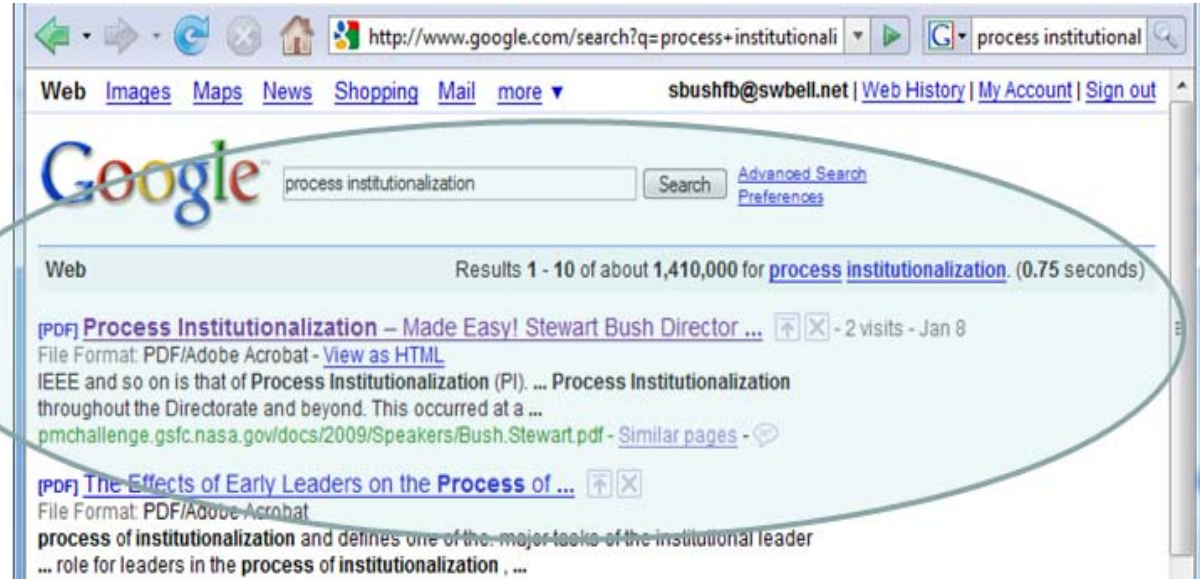
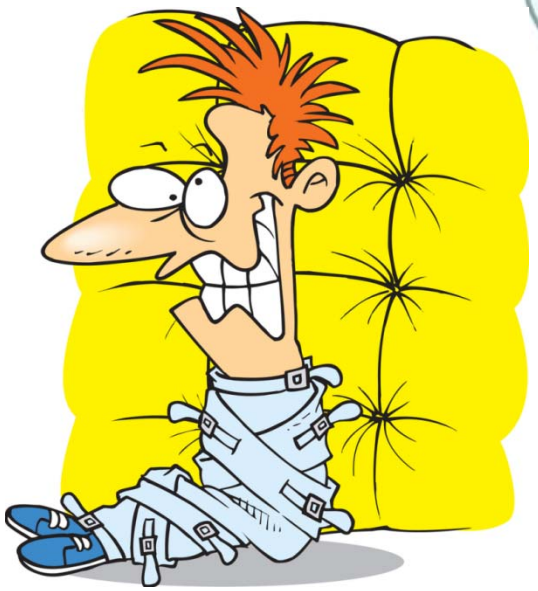
Process Institutionalization

According to Google





How to Achieve Institutionalization

- **Organization wide Culture Adjustment**
  - Visible, Persistent & Genuine Display of Management buy-in
  - Key people with strong Conceptual & Operational Process Skills
  - Commitment to a process-centric lifestyle
  - Continuous Improvement Expected – Everyone is involved
  - Process Mentality Woven into Organizational Fabric – Survives all Storms
- **Organization wide Support**
  - Tools and Infrastructure supporting the methods, practices and procedures
  - Strong multi-level training, references, examples, and general support
  - Internal Marketing – Process Models, Info/Results sharing, Community
  - Diligent Feedback, Monitoring and Improvement Response
- **Expensive, Time Consuming, but Worth it**

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Compelling Numbers

Performance Results Summary – SEI Data

25 Groups

Performance Category	Median	Number of Data Points	Low	High
Cost	20%	21	3%	87%
Schedule	37%	19	2%	90%
Productivity	62%	17	9%	255%
Quality	50%	20	7%	132%
Customer Satisfaction	14%	6	-4%	55%
Return on Investment	4.7 : 1	16	2 : 1	27.7 : 1

http://www.sei.cmu.edu/cmmi/2005results.html

"CMMI® Version 1.2 & Beyond" December 15, 2005
Mike Phillips, Software Engineering Institute, Carnegie Mellon University

BPSCM Story

- **Space Life Sciences Directorate (SLSD) at JSC faced a challenge**
  - Declining budgets
  - CCB activities - labor intensive
  - New Configuration Management (CM) standard
- **Tietronix tasked to Implement a more automated CCB System**
  - Enforce the CM Plan, Control Board Requirements and new CM Standards
  - Provide a Closed Loop Process
  - Reduce administrative Effort

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Automate - BPSCM Change Process

Initiator

CM Admin

CR

CR

Evaluators

CR w/comments

Control Board

Directive & Action Item

Completed change

Change Request submitted

CM Admin reviews **CR** and delivers to Evaluators

Evaluators attach comments

Control Board Decides on change
If yes – **CR** is approved
Board Chairman instructs CM Admin:
Create **Directive** w/**Actions** for change

Directive delivered with attached **Actions** describing changes to be made
Change is made & process completed

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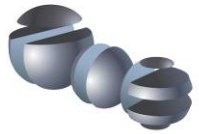
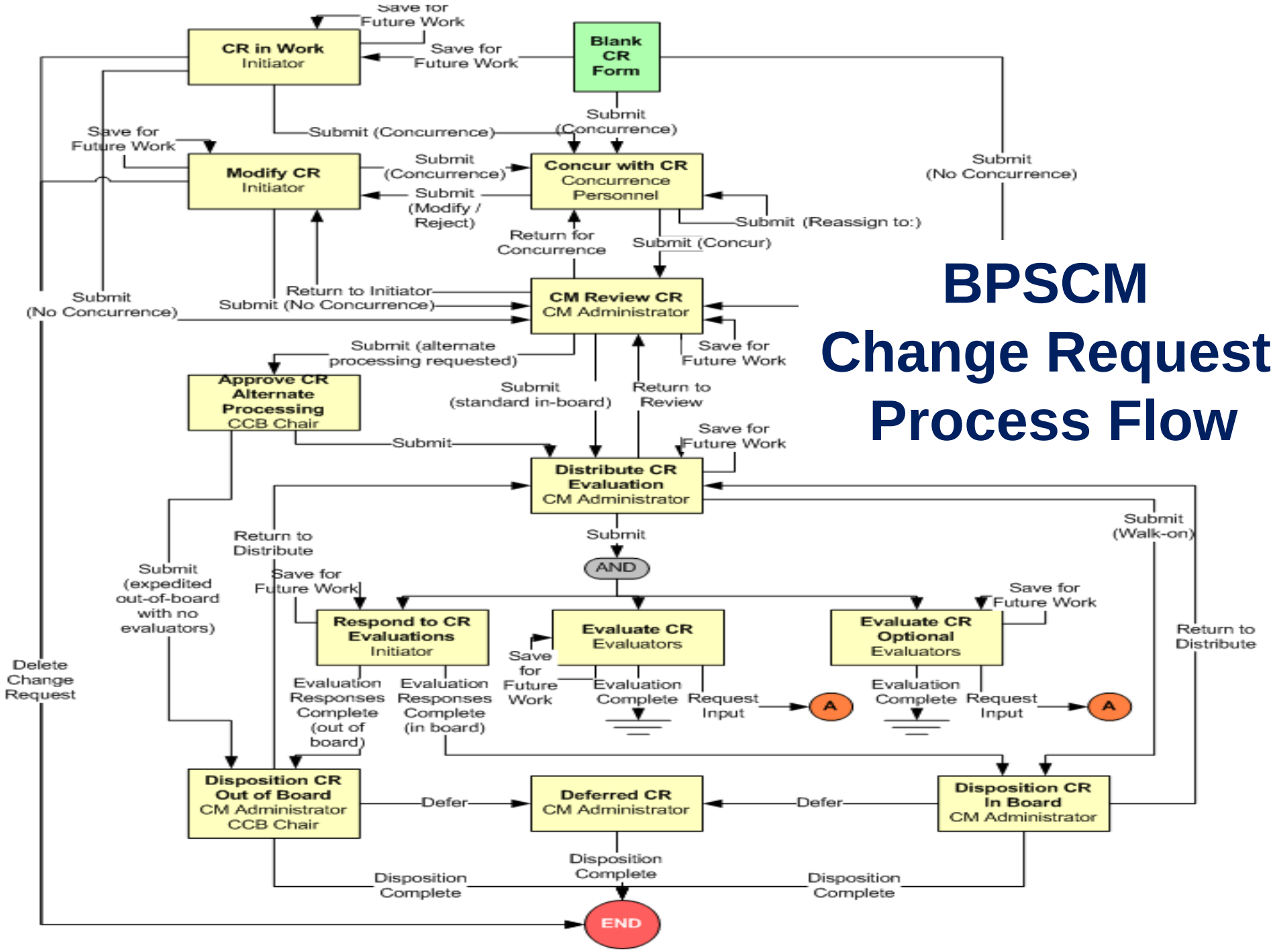


BPSCM Change Request Process Flow



BPSCM Story – The Beginning

- **Conflicting requirements**
  - Multiple boards – unique processes
    - *Some boards had additional steps before bringing a Change Request to the board*
  - Configuration management requirements loosely supported
    - *The Change Request was approved but we noticed a problem and we need to fix it*
  - Direction to do more with less
- **Incomplete requirements**
  - Electronic process functions differently than paper/manual process
  - Prototypes to drive out additional requirements
- **Reluctance to change**
- **Lots of Interaction**

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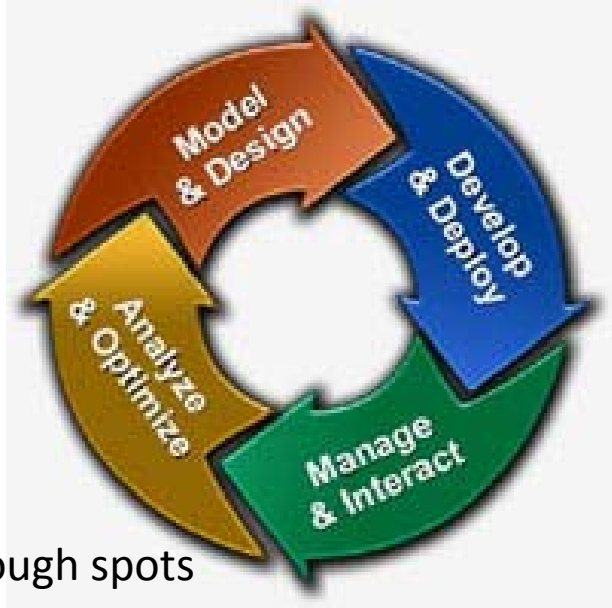
BPSCM Story – The Middle

- **Process Centric Approach**
  - **Graphically modeled a process based on**
    - Existing SLSD processes
    - New CM requirements
    - Stakeholder interviews
  - **Used tool to 'code' the process**
    - GFE tool – TieFlow – SBIR Product
    - Prototype used to show the process
    - More interviews helped refine the process
  - **Deployment – execute the process**
    - Monitor & analyze user experience, identify rough spots
    - Found operational & process issues
    - Led to process refinement & next round …



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BPSCM Story – The End

- **Requirements Met**
  - Compliance with the New CM Plan
  - Increased efficiency:
    - **333%** productivity gain for CM admins - ***from 8/6 boards → 6/15***
    - CCB artifacts, milestones and communications more accessible
    - Reminders & automatic notifications streamlined operations
  - Increased participation
  - Increased quality of Board Meetings:
    - Attendees are much better prepared
    - Management & participant visibility greatly enhanced
- **Current Status**
  - Used on all SLSD Boards ~45
  - **SLSD CCB Process Institutionalized**
  - Slated for use on a few KSC boards and 1 @JSC KA Directorate
  - ~1000 users
- **Truly Unusual**
  - Overheard, unsolicited – “The CM tool is awesome”

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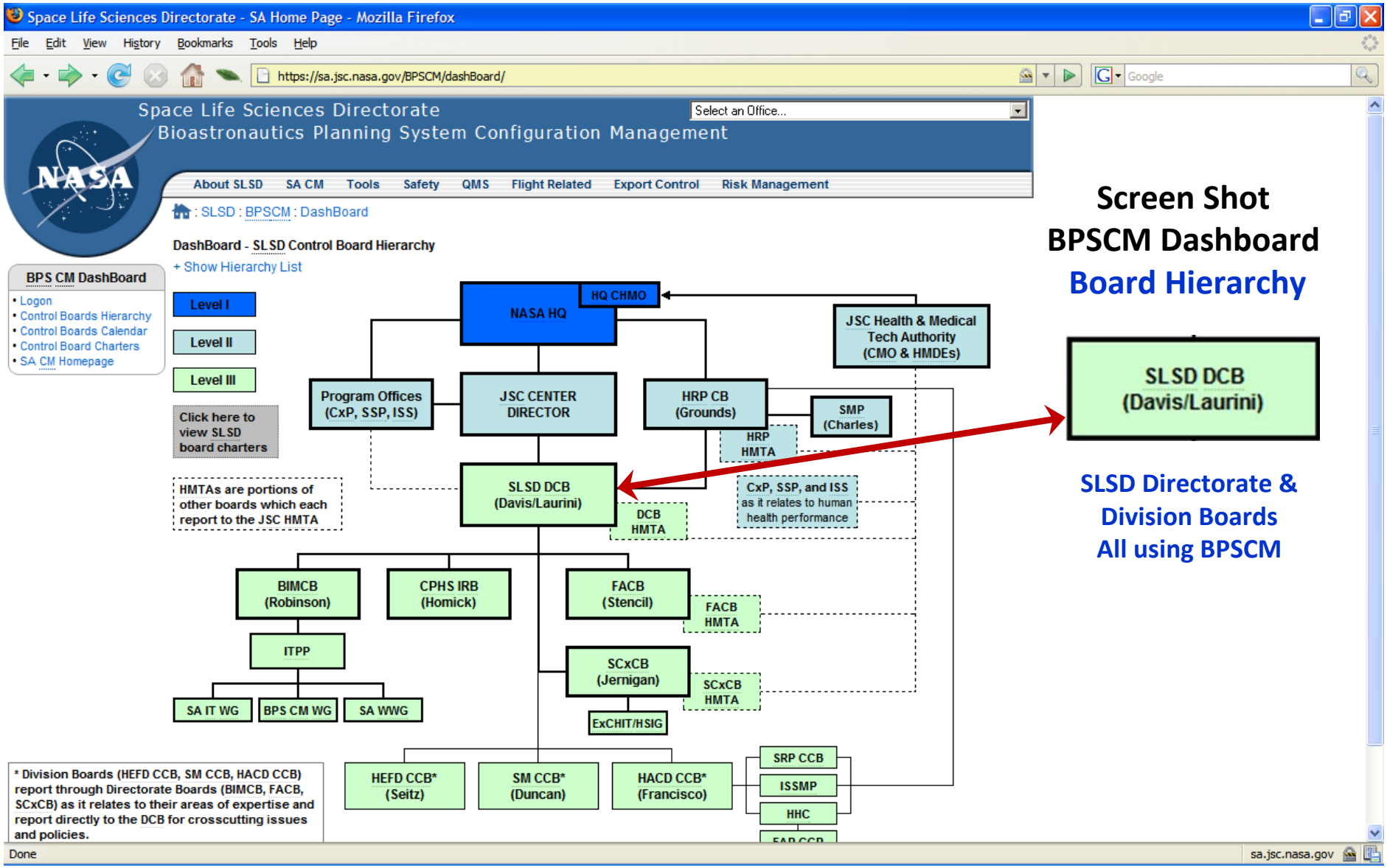
Board Hierarchy Chart - Dashboard

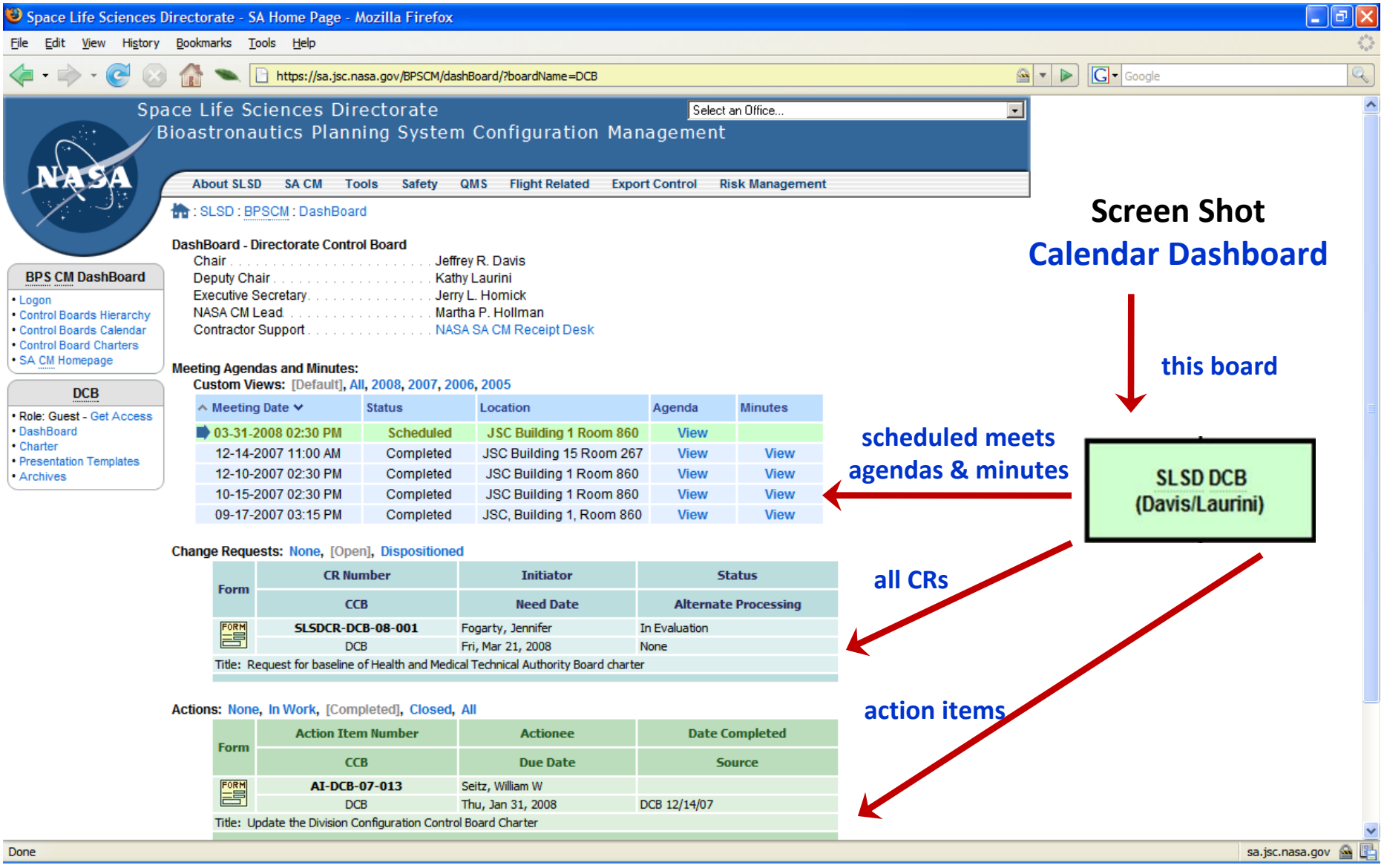


Screen Shot
BPSCM Dashboard
Board Hierarchy

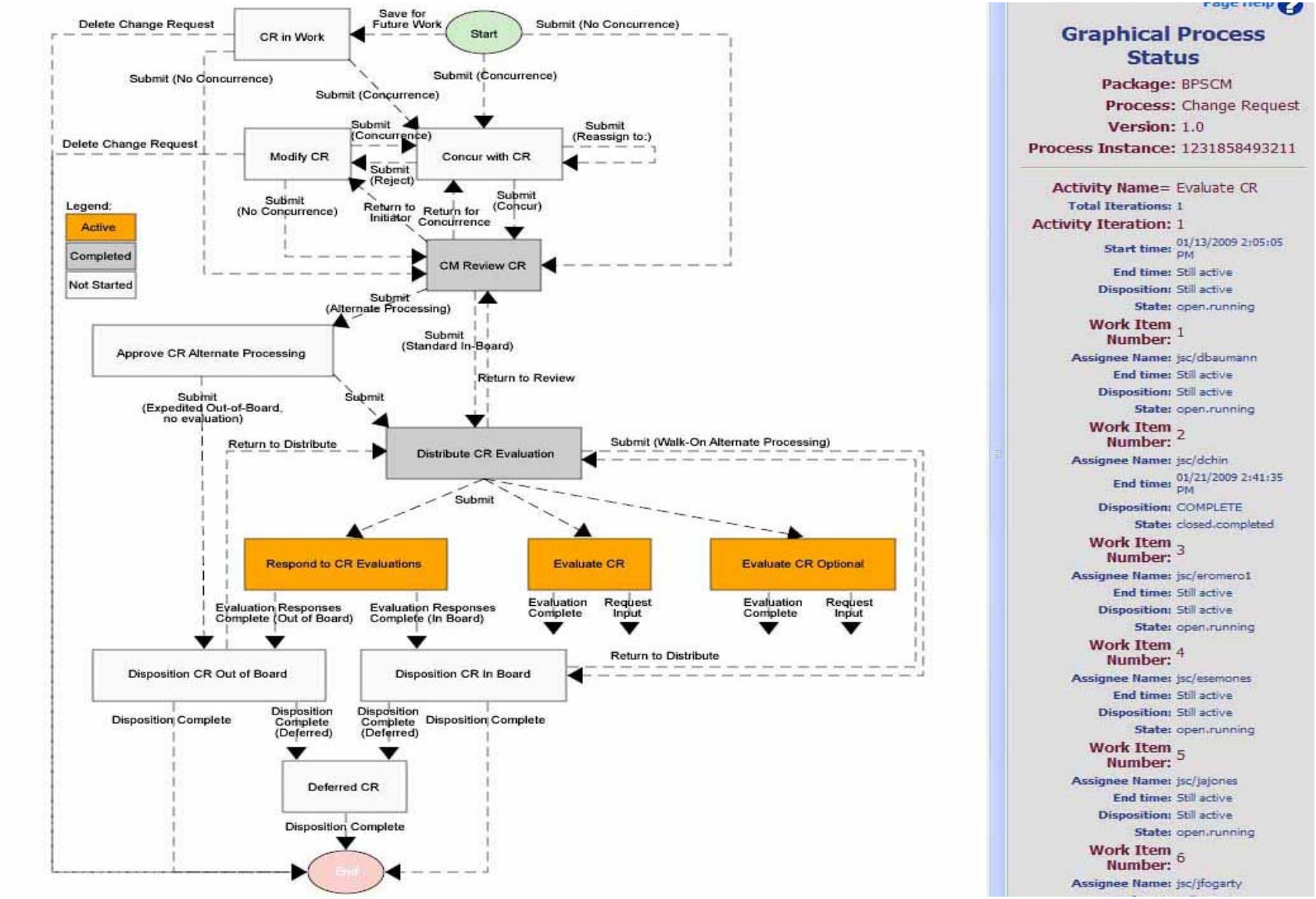
SLSD DCB (Davis/Laurini)

SLSD Directorate & Division Boards All using BPSCM

Board Calendar Dashboard



Real Time Process Status (Screen Shot)



Short Story Analysis Sheet

Story Title	**BPSCM – A Clean and Well Lighted Process**
Setting & Time	JSC – Space & Life Sciences Directorate (SLSD), 2005 to Today
Characters	**CM Manager** In charge of CM for SLSD – Needs to comply to new CM Plan **SLSD Mgt.** Interest in Standard CM **CM Lead** Ran CM operations - staff of 8 very busy CCB Admins **Control Boards** 10 Boards to initially use BPSCM → 45 Boards now **Division Chief** Don't fix if not broken. New process initiative? Mgt use of data?
External Conflict **Internal Conflict 1** **Internal Conflict 2**	Need Closed Loop Process – not much $s BPM needs more detailed process to actually 'run' Divisional Change Resistance – wont' adopt
Plot Climax & Resolution	**Division Chief** says No/Nada to BPSCM CCB Ops Not Broken New Visibility – possible issue **SLSD Mgt.** - Stood Ground based on: Large Productivity Gains, over 3x for admins, all roles felt they benefitted New visibility – good for all w/little chance of abuse Initial Resistance to change, no surprise. Rapid dissipation of resistance was. More detailed analysis on next slide
Theme	Process Centric Technology – **So far so Good**

Institutionalization Catalysts

(New Technology) **Feature**

- **Run the Process – Automate**
  - Clerical & Tedious
  - Collection of:
    - Status, Metrics, Audit info
    - Auto analysis of above info
  - Task Handoffs
  - Compliance
  - Collaboration
- **Visibility**
  - Reports
  - Audit Trail
  - Monitors - Process
- **Communication**
  - Web Application
  - Alerts & Notifications automated

Benefits

- **Managers**
  - Non-Invasive Real Time Status
    - Objective & Detail to any level
    - Less Time/Effort to get accurate Project info
    - Less worries – compliance & reality
  - Improved Ops & Process Insight
    - Abundant Decision Support Info
    - Vastly more data for Improvement
  - Time for Higher Level Functions
- **Workers**
  - More efficient
    - Less time on Mgt. reports & the like
  - Less clerical, more high level work
- **Inspectors, Auditors**
  - Less Effort
  - Data collection & scrubbing
    - Checking compliance
  - Less Contentious Interaction
- **Everyone**
  - less training needed
  - higher process awareness

Extrapolate: BPM for larger Processes

- **Try BPM on NASA full Engineering Processes**
  - Will we see BPSCM type results – quick Adoption & Institutionalization?
- **New tool – SDA – Software Developer's Assistant**
  - Using underlying BPSCM Technology – extended
  - Full BPM Infrastructure – Process Engine, Rules, Web Services API, …
- **SDA now with many Software Process Templates:**
  - NPR 7150.2 compliant – Class A – H
  - Waterfall, Iterative, Agile
  - CMMI Process Mappings
  - RIDs, Action Items, PAL
  - Reports, Dashboards, Audit Trail, SDFs
  - Integrated with CM Systems, Microsoft Project, Tools

API	Application Programming Interface	NPR	NASA Procedural Requirements
BPM	Business Process Management	PAL	Process Asset Library
CM	Configuration Management	RID	Review Item Discrepancy
CMMI	Capability Maturity Model Integration	SDF	Software Development Folder

SDA Current Use

- **3 NASA Projects – Engineering Directorate**
  - LIDS Software – Low Impact Docking System
  - Orion Software PDR
  - Radiation
- **3 NASA Projects – Mission Operations Directorate (MOD)**
  - PLATO
  - Timeliner – Several Bundles
  - CxPASS – Four CSCIs
  - Intent – use SDA on all new software programs
- **3 Non-NASA**
  - USA – Constellation Process Modeling & Simulation (completed project)
  - Micro Transponder – FDA Medical Device process
  - Micro Transponder – Grant Process
  - Lockheed is interested - Orion Flight Software
- **9 External Projects – Good amount of use & feedback**
  - ~100 users Outside of Tietronix
  - 10 Tietronix Internal projects

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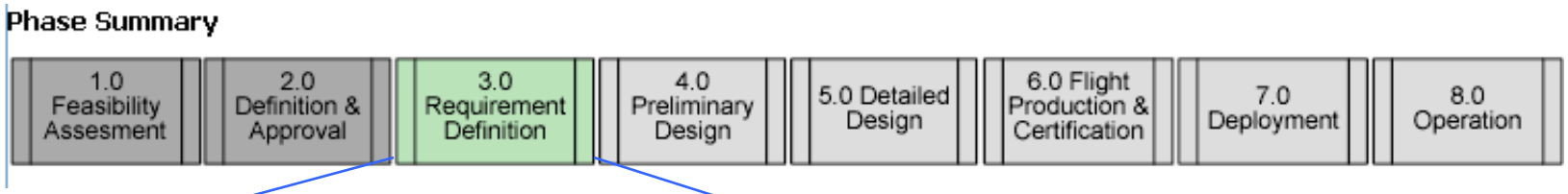
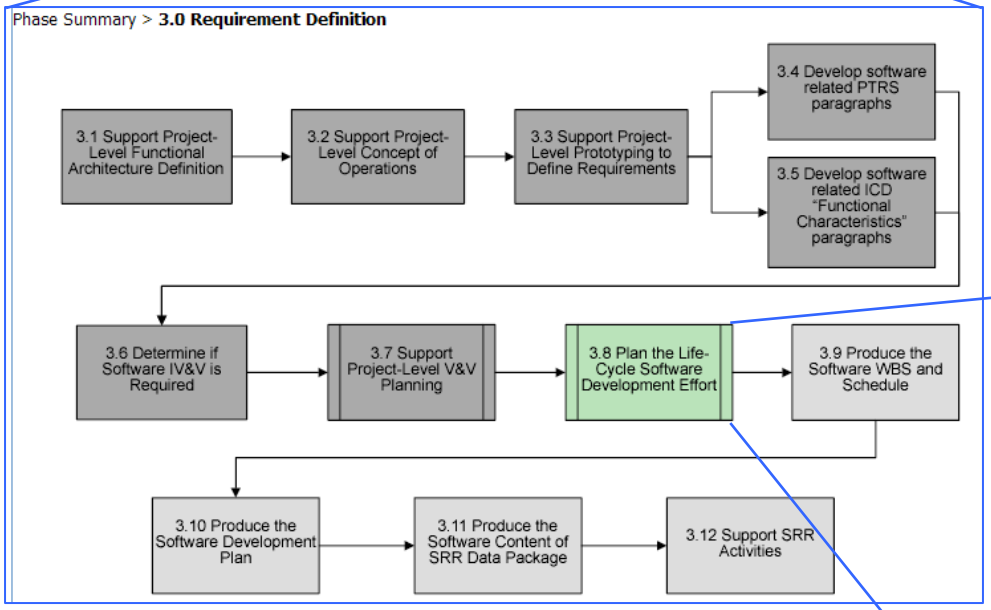
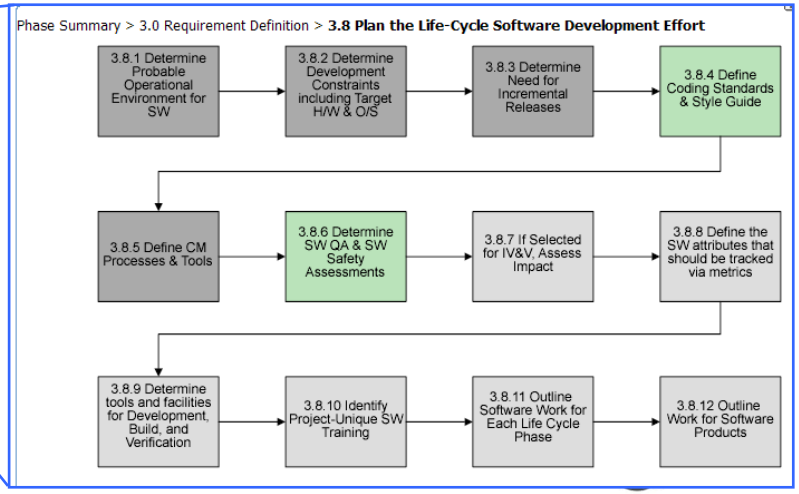
NASA Class A – Software Process





Example Process
EA-WI-025 – GFE Flight SW/Firmware

230 Activities

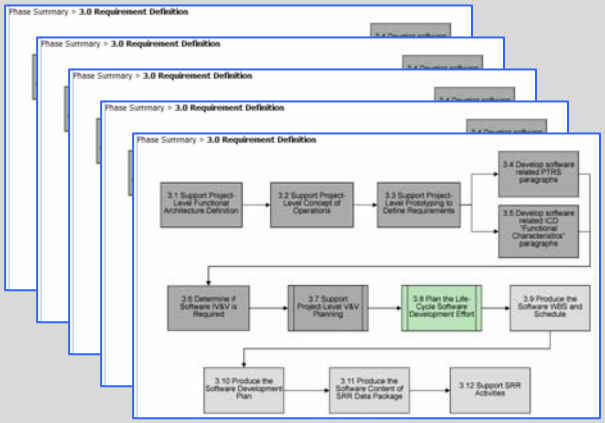


SDA Guides/Leads team through the process

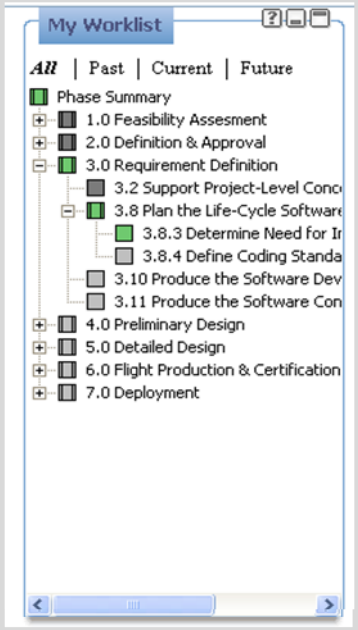
SDA - Process Management

Any SW Process →

Processes Enactment Tool

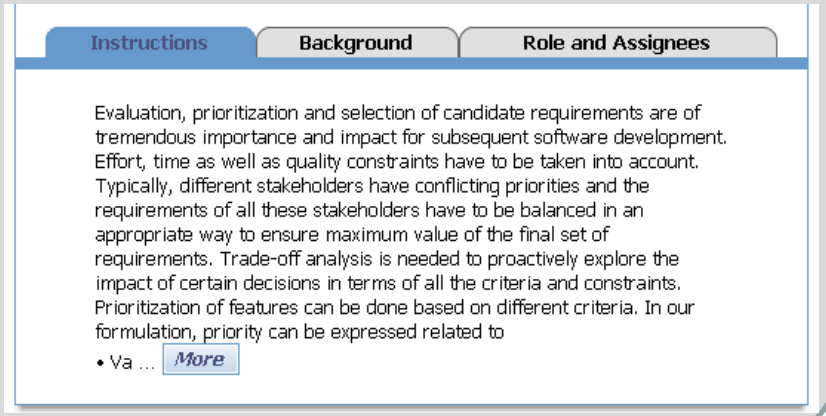


Individual ToDo List



Each Team Member ↑

Task related Instructions

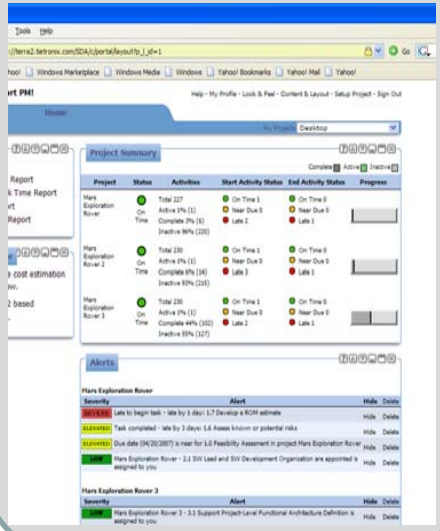


Document Templates Examples & References

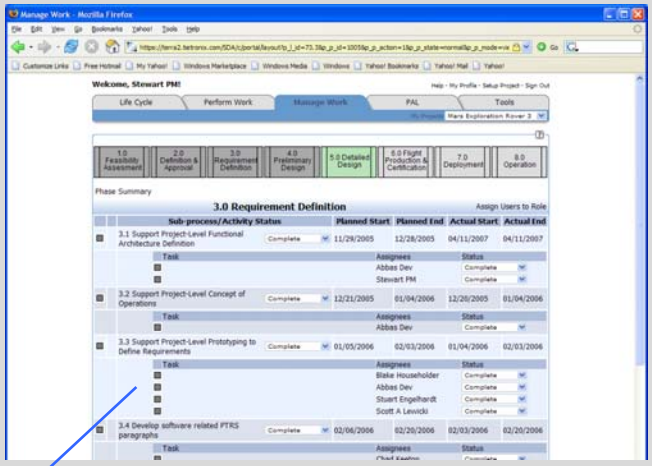
← **Each Activity** ↑

SDA - Project Management

Multiple Project Dashboard View



Task Assignments



MS Project

Reports
Project Status & Health
Audit Trail, etc.

☐	3.2 Support Project-Level Concept of Operations	Complete	12/21/2005	01/04/2006	12/20/2005	01/04/2006
	Task			Assignees	Status	
	☐			Abbas Dev	Complete	
☐	3.3 Support Project-Level Prototyping to Define Requirements	Complete	01/05/2006	02/03/2006	01/04/2006	02/03/2006
	Task			Assignees	Status	
	☐			Blake Householder	Complete	
	☐			Abbas Dev	Complete	
	☐			Stuart Engelhardt	Complete	
	☐			Scott A Lewicki	Complete	
☐	3.4 Develop software related PTRS paragraphs	Complete	02/06/2006	02/20/2006	02/03/2006	02/20/2006

SDA Observations & Results – thus far

- **SDA Concept well received**
  - Managers especially enthusiastic on automatic status capture
- **Lots of feedback**
  - Usability
  - Enhancement Suggestions
  - Eerily upbeat
- **Most Believe they are more Productive**
  - With good opportunity for additional gains
- **Management, Engineers – same side of fence**
  - Unusual lack of resistance
- **Everyone a Process ~~Critic~~ Knowledgeable Citizen**
  - Process awareness & understanding higher across the board
  - Parallels a trend in the Business Intelligence (BI) market
    - Next Generation BI products empower all to analyze the enterprise

Tietronix - Process Centric Technology

SBIR Awards **Process Engine**

- SBIR Phase I Feb 01 – Aug 01
- SBIR Phase II Jan 02 – Jan 04

Funded by JSC Engineering Directorate

SBIR Awards **SDA**

- SBIR Phase I Jan 04 – Jul 01
- SBIR Phase II Nov 04 – Jan 06
- SBIR Phase III Sep 06 – Mar 09
- SBIR Phase III – being planned

Funded by JSC Engineering Directorate – Phase I & II
JSC Engineering & MOD Directorates – Phase III's

BPSCM

Reports	Web Interface	Dashboards
BPSCM - Application		
TieFlow V1.0 Process Engine		
Database		

SDA

Reports	Web UI	Flash	Dashboards	Tools
SDA - Application		Web Portal	Process Library	WSI*
TieFlow V2 Process Engine			Rules Engine	WSI*
Database		Versioning		WSI*

WSI* = Web Services Interface
SDA includes a full BPM Infrastructure

SDA was originally built to help engineers with rigors of Class A Software Process.
New Technology *required for the process engine to deal with 'real-life'* ***Process Exceptions***

Commercial Process Centric Technology - BPM

- **Many Vendors – Larger, Infrastructure types:**
  - IBM, Oracle/BEA, Tibco, Software AG, EMC/Documentum, SAP, …
- **Pure Play Vendors – BPM products only**
  - Pegasystems, Global360, Metastorm, Savvion, Appian, Lombardi, Intalio, K2, …
- **BPM Market – Fast Adopting & Growing Market**
  - Mature technologies combined with quietly disruptive results
    - Technologies: Workflow, Rules, Web Services/SOA, Web Applications
  - BPM Applications focus on automating core business processes & improvement
    - Attributes: productivity, efficiency and agility gains = more competitive, flexible & profitable
  - Vendors love it
    - High Price points for product and services – high ROIs justify the price
    - Low Hanging fruit for vendors: Supply Chain, Loan Processing, CRM, Procurement, Fin. Clearing …
    - High Hanging Fruit – NASA/DOD/Agency Software and Engineering Process
- **Market Trends – Observation & Speculation**
  - Too Many Vendors → Consolidation & Standardization will change the picture
  - Platform/Product likely to commoditize … quickly
  - **High Value likely to be**: Content & Application Creation, Integration & Maintenance
    - Content = processes & associated objects (artifact definitions, examples, templates, and so on)

Best Candidate Projects for BPM

Some of the symptoms that could help you identify a process improvement opportunity include:

- **High labor costs to execute the process**
- **Inconsistent work quality**
- **Inaccurate forecasting of work completion**
- **Difficulty in providing status reports**
- **Employee and customer satisfaction issues**

From Lombardi White Paper – "Getting Started with BPM – An Introduction to Business Process Management", 2008

NASA & DOD Mission Critical Software/Systems Engineering - possible fits

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Learn more about BPM

- **Analysts**
  - Gartner – NASA has an account?
  - Forrester
  - Aberdeen, Butler, IDC, Yphise, others
- **Organizations**
  - BPM Institute – www.bpminstitute.com or .org
    - Bruce Silver Associates – www.brsilver.com - Blog
  - BPM.com – www.bpm.com
  - BPM Basics – www.bpmbasics.com
  - Abundance of good info – Lots of vendor sponsorship too.
- **Vendor sites have good info too –** with a little bias

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Automate Engineering Processes

- **Use BPM or Process Centric Technology Infrastructure**
  - Many Vendor Options
  - NASA/Tietronix Technology
  - Roll your own

- **Beyond using BPM technology you will need to:**
  - Create Applications using the underlying BPM Technology With structures for:
    - Software, Hardware, System hierarchies – CSCIs, CSCs, CSUs, …
    - Project Organizations – hierarchies, linkages, WBS's, conventions, …
      - CMMI & NPR compliance, Engineering process/project specific status & audit trail reporting
    - Integrations with other tools – Microsoft Project, CM systems, Defect tracking, …
  - Provide unique Logic for:
    - Process Exceptions – Re-do part of all of a process area, Start work early, …
    - All roles, access control, How organizations interact, escalation, …
    - Configurability, Tailoring, and Customization
- **Seems the best & quickest path:**
  - Common Systems Engineering Framework Realization

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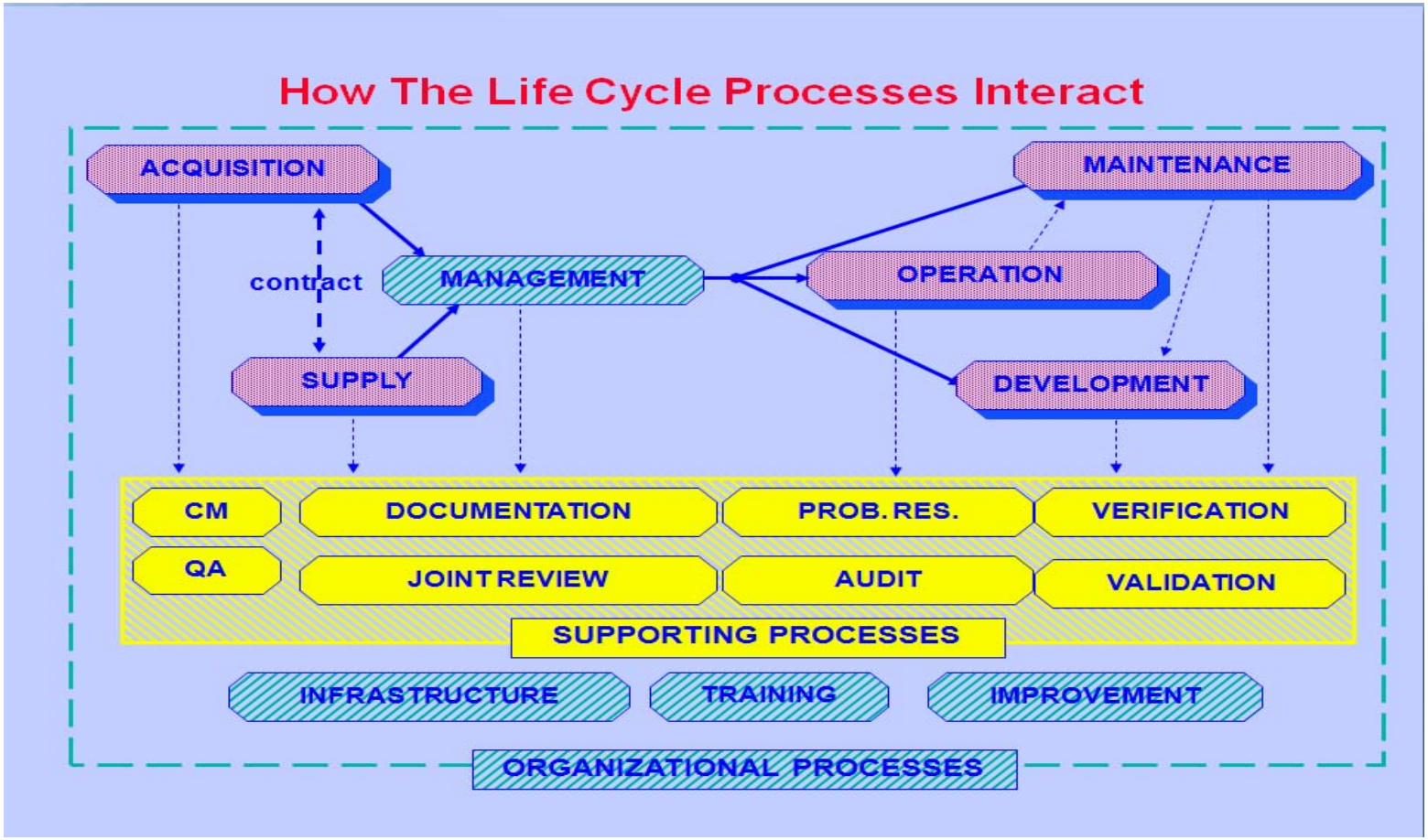
The Future – Software Engineering

IEEE 12207 Process Relationships – from Navy SPAWAR

17 Interacting processes – for complete SW Lifecycle



Without Process Technology – Opinion – This will not effectively be achieved

The Future – Systems Engineering

The 17 Common Technical Processes – from NASA Systems Engineering Handbook

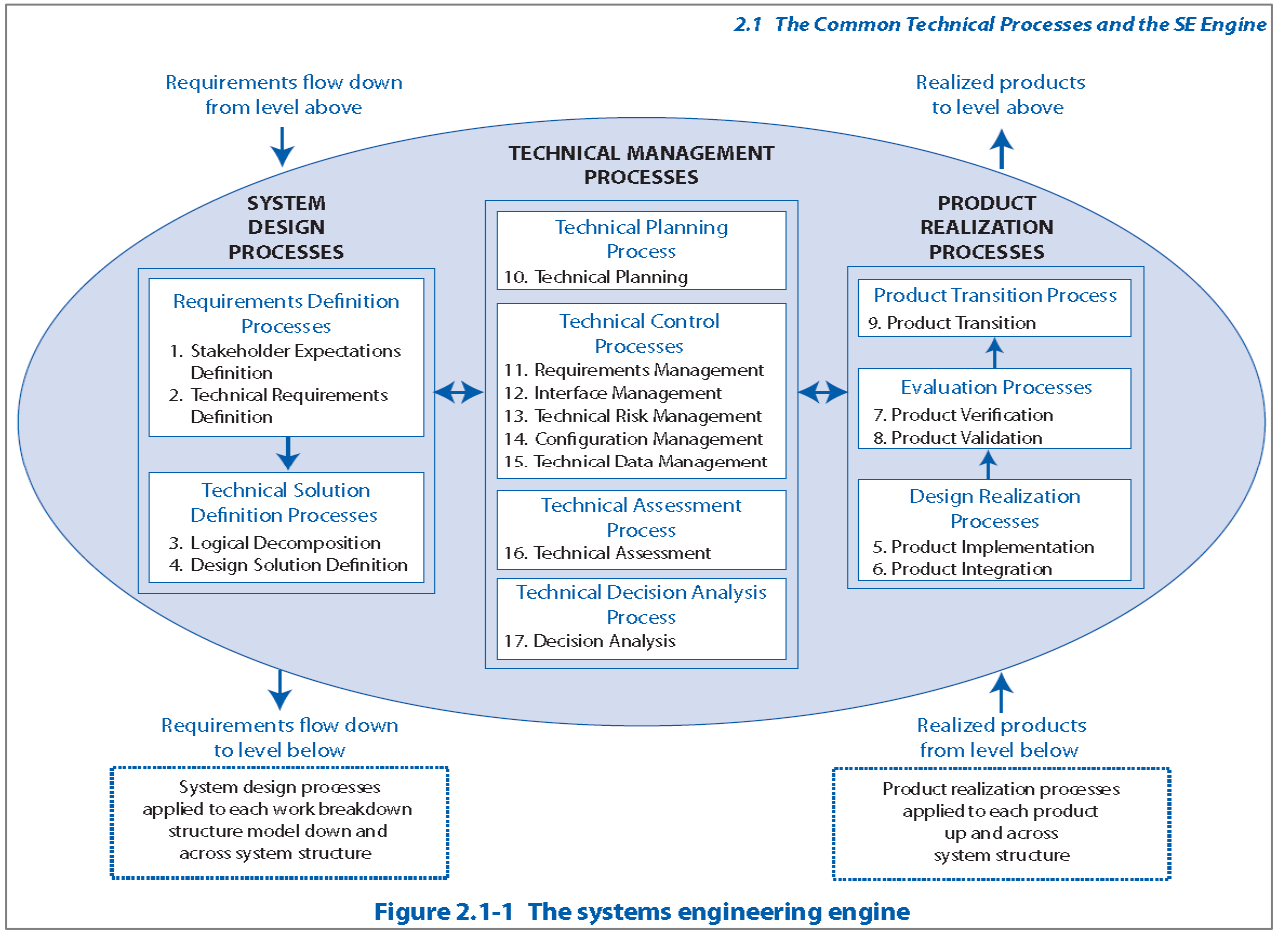


Figure 2.1-1 The systems engineering engine

Without Process Technology – Opinion – These too will not be Effectively Realized

Final Thoughts – Q&A

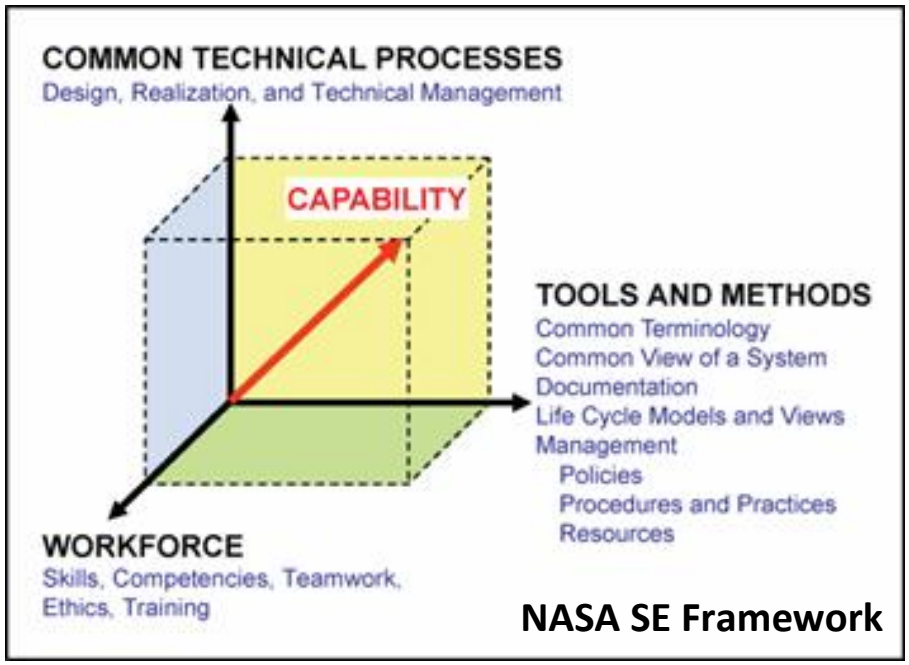


Figure 1-1 SE Framework from NPR 7123.1A

Process Technology

for

Mission Success

For the efficient and effective engineering of NASA Systems

Stewart Bush
Director – Process Technology

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